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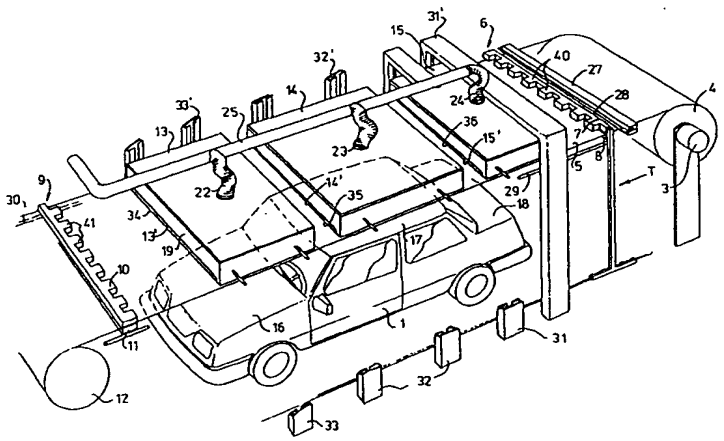

(57) Abstract

The invention relates to a method for applying a protective film (5) to a shaped surface (15, 16, 17, 18) of a vehicle (1) in the lengthwise or in the widthwise direction. A film sheet (5) is unwound from a stock roll (4) and placed in contact with the shaped surfaces of the vehicle. The method is characterised in that: the film sheet (5) is brought under tension alongside or above the shape surface to be covered; a hollow mould (13, 14, 15) having the shape of the shaped surface is brought close to the film sheet, which mould is provided with a resilient, porous inner surface (13', 14', 15', 19, 20, 21), as well as with pressure means (22, 23, 24, 25, 26) for applying a vacuum and/or overpressure to the inner surface; a vacuum is applied to the inner surface (13', 14', 15', 19, 20, 21) of the mould and the film sheet is drawn into contact with the inner surface of the mould by suction; the film sheet is cut through by cutting means (34, 35, 36) around the periphery of the mould, and the mould is pushed against the shaped surface so that the film is attached to the shaped surface such that it adheres. Fast, efficient application of the film on the shaped surfaces, without air inclusions, is obtained by the use of the shaped moulds and a constant tension on the film sheet during the application thereof.

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# Method and installation for applying a protective film to vehicles

The invention relates to a method for applying a protective film to a shaped surface of a vehicle, a film sheet being unwound from a stock roll and brought into adhesive contact with the surface of the vehicle.

In the production process for vehicles, such as, for example, cars, a self-adhesive protective film is applied on top of the paint coat after the latter has been applied. Said film, or tape, is unwound by hand from a stock roll and cut off to the desired width. Good contact between self-adhesive film and the parts of the car is then achieved by hand, the air bubbles trapped by the film being carefully brushed away using a soft brush or spatula. In particular the horizontal parts, such as the bonnet, the roof and the boot, are covered with film which serves to protect the new cars against outside influences, such as bird droppings, acid rain and the like. A self-adhesive film can also be applied to the vertical parts, such as the side panels, doors and the like.

Applying the self-adhesive film by hand requires the deployment of about 8 staff in a finishing line and is therefore very time consuming. One aim of the present invention is to provide a method and installation with which the application of, optionally self-adhesive, film can be automated in an efficient manner and with which fast and accurate positioning of the film on the parts of the vehicle which are to be protected can take place. A further aim of the present invention is to provide a method and installation with which the application of the film can take place in as small a number of steps as possible, employing a small number of staff (for example 2).

To this end the method according to the invention is characterised in that:

- the film sheet is brought under tension alongside or above the shaped surface to be covered,
- a hollow mould having the shape of the shaped surface is brought close to the film sheet, which mould is provided with a resilient, porous inner surface, as well as with pressure means for applying a vacuum and/or overpressure to the inner surface,
- a vacuum is applied to the inner surface of the mould and the film sheet is drawn into contact with the inner surface of the mould by suction,
- the film sheet is cut through by cutting means around the periphery of the mould, and
- the mould is pushed against the shaped surface so that the film is attached to the

shaped surface such that it adheres.

By drawing the film sheet into the preformed moulds by suction and cutting it to size, said film sheet is brought into the shape of the surface to be covered before it comes into contact with the latter, with the result that the inclusion of air after application is minimal. Furthermore, as a result of the resilient nature of the porous surface, which, for example, can be made of a porous plastic or rubber, a close-fitting pressure contact between the film and the parts of the vehicle which are to be covered can be obtained, as a result of which good adhesion of the film can take place. With the method according to the invention the film can be applied quickly and accurately to the vehicle. The film sheet can have been provided with an adhesive and be of self-adhesive design, but it is also possible to coat the film with an adhesive, for example after being drawn into contact with the mould by suction or prior to this, or to use a non-adhesive film, in which case the surfaces of the vehicle which are to be covered are provided with an adhesive, for example by spraying said surfaces with an adhesive.

According to one embodiment of the method according to the present invention, after the mould has been pressed against the surfaces of the vehicle, an overpressure can be applied to the inner surface in order to ensure that the film is pressed against said surface such that it fits tightly and all air inclusions are expelled.

One embodiment of the method according to the present invention is characterised in that:

a. a free end of the film sheet is clamped in a conveyor,
b. the conveyor is moved to a stationary clamping device located some distance away, so that the film sheet is unwound from the stock roll,
c. the conveyor transfers the free end of the film sheet to the clamping device,
d. the conveyor is returned to the stock roll and once again brought into clamping engagement with the film sheet, close to the stock roll,
e. the mould is brought into engagement with the film sheet and the cutting means are activated,
f. the film sheet is cut through across its width at a position between the conveyor and the stock roll and is transferred to a take-up roll,
g. the mould is brought into contact with the shaped surface, after which
h. steps a. to g. are repeated.

A film sheet of the desired length is stretched between the clamping device and the

mobile conveyor for each vehicle. The clamping device and the conveyor can be of mechanical construction and engage on the film sheet by means of clamping jaws, but can also clamp the film sheet via a vacuum by suction or by electrostatic attraction. Film is then drawn into contact with the moulds by suction and cut off around the periphery of the moulds, after which the remnant of the film sheet can be removed, for example by winding it on a take-up roll. Because the film sheet is under tension during every process step, accurate suction into the moulds can be obtained and the film can be applied to the vehicle without air inclusions.

The installation according to the present invention can, for example, comprise a clamping device and conveyor which are provided with projections which face one another and which engage in one another when the conveyor bears against the clamping device, so that accurate transfer from the conveyor to the clamping device can take place. The clamping device and the conveyor can have movable clamping jaws which are operated hydraulically, pneumatically or mechanically, for example by means of plates fixed to the jaws.

The method and installation according to the invention will be explained in more detail with reference to the appended drawing. In the drawing:

Figure 1 shows a perspective view of an installation for applying a film to a car,

Figure 2 shows a plan view of the conveyor and the clamping device,

Figures 3 - 6 show, respectively, a side view of the clamping device and conveyor according to Figure 2 in a position in which they are remote from one another, in a position in which they are in contact, with film being transferred from the conveyor to the clamping device, and in a return position of the conveyor, and

Figure 7 shows a mechanical device for simultaneously opening the conveyor and closing the clamping device when the two are in contact with one another.

Figure 1 shows a vehicle 1, in particular a car. However, the invention is not restricted to covering cars with a plastic film but can also be employed for boats, trains, aircraft, engines and other vehicles.

The installation comprises a stock roll 4 with a plastic film wound on a spool 3. The film can, for example, be of self-adhesive design, but it is also possible that the film does not have any adhesive characteristics. The film can also have been made from a material

other than plastic, for example from paper.

The film sheet 5 is fed from the stock roll 4 to a conveyor 6 which is provided with two clamping jaws 7, 8. A stationary clamping element 9, which likewise has two clamping jaws 10, 11, is arranged some distance away from the conveyor 6. Downstream of the clamping element 9, viewed in the transport direction T of the film sheet, there is a take-up roll 12. Three moulds 13, 14, 15 have been arranged above the film sheet 5, each of which moulds is provided with a shaped inner surface 13', 14', 15', the shape of which corresponds to the surfaces 16, 17, and 18 of, respectively, bonnet, roof and boot of the car 1. Those parts of the moulds 13, 14, 15 which come into contact with the car 1 have been made of a resilient, porous material 19, 20, 21. A vacuum chamber 22, 23, 24 is located above the porous material 19, 20, 21, which vacuum chamber is connected to a vacuum line 25 which is connected to a vacuum pump not shown in the figure. In addition, a further clamping device 27 and a cutting device 28 for cutting through the film are located between the stock roll 4 and the conveyor 6.

The installation according to Figure 1 functions as follows. The free end of the film sheet 5 is first of all clamped between the clamping jaws 7, 8 of the conveyor 6 in a position located close to the stock roll 4. The conveyor 6 then moves in the transport direction T until it is in contact with the stationary clamping element 9. During this operation the stationary clamping element 9 is in the opened position and then closes while the clamping jaws 7, 8 open. The conveyor 6 then moves back to the starting position shown in Figure 1 along horizontal guides 29, 30 (see Figure 2). Once back in the starting position, the clamping jaws 7, 8 are moved towards one another again so that the film is stretched between the clamping element 9 and the conveyor 6. The clamping jaws of the clamping device 27 are then closed and the moulds 13, 14, 15 are moved downwards over vertical guides 31, 31', 32, 32', 33, 33' until they are in contact with the film sheet 5 and the film is drawn by suction until it is in contact with the inner surface 13', 14', 15' of the porous material 19, 20, 21. Cutting devices 34, 35, 36 located around the periphery of each mould 13, 14, 15 are then activated. Said cutting devices can have been constructed as a hot wire, as a blade or as an ultrasonic cutting device or other equivalent cutting means. After the film sheet sections have been drawn in by suction and cut out from the film sheet, the remnant of the film sheet 5 is cut through with the aid of a cutting device 28. The cutting device 28 can once again comprise a hot wire, but can also have been made up of other means, such as, for example, a blade or an ultrasonic cutting

device.

The jaws 10, 11 of the clamping device 9 are then opened and the residual material from the film sheet 5 is wound on the take-up roll 12, while the conveyor 6 is moved in the direction of the take-up roll, after which the conveyor 6 returns to the stock roll. When the residual material of the film sheet below the moulds 13, 14, 15 has been removed in this way, said moulds are moved downwards along the vertical guides 31, 31' - 33, 33' until they come into contact with the bonnet 16, the roof 17 and the boot 18. An overpressure is then applied to the vacuum line 25 so that the film is pressed firmly against the parts to be protected and any air bubbles are expelled. The moulds 13, 14, 15 are then withdrawn and the abovementioned steps can be repeated.

In an alternative embodiment it is also possible to omit the conveyor 6, the blade 28 and the clamping device 27 and to maintain the tension in the film sheet 5 by the action of the clamping device 9 and the take-up roll 12 alone. With this arrangement, after the film has been drawn by suction into contact with the porous inner surfaces 13', 14', 15' of the moulds 13, 14, 15 and the material drawn by suction into contact with the moulds has been cut out, the moulds are placed, through the holes made in the film sheet, into contact with the bonnet 16, the roof 17 and the boot 18 and withdrawn again through said holes. During this operation the clamping jaws 10, 11 of the clamping element 9 are closed. The clamping jaws 10, 11 are then opened and the residual material of the film sheet 5 is wound on the take-up roll 12 while fresh film sheet material is unwound from the stock roll 4. In this case the spool 3 and the take-up roll 12 are driven.

Although it is shown in Figure 1 that the film is applied to the vehicle in the lengthwise direction, it is also possible to apply three film sheets of a smaller width transversely with respect to the vehicle, which results in less loss of material.

As can be seen from Figures 2 to 6, the clamping jaws of conveyor 6 and of the clamping element 9 are provided with a number of projections 40, 41 which engage in one another. As can be seen from Figure 3, the film sheet is clamped between clamping edges 42 at the location of a projection 40. When the projections 40 of the closed clamping jaws 7, 8 of the conveyor 6 are in contact with the projections 41 of the opened clamping jaws 10, 11 of the clamping element 9, the film sheet 5 is taken over, at positions located between the projections 40, by the projections 41 of the clamping element 9, the clamping jaws 10, 11 of which are closed to the position as shown in Figure 5. The opened conveyor 6 then moves back over the film sheet 5 to the stock roll 4, as shown in Figure 6.

The clamping jaws 7, 8, 10 and 11 can be hydraulically, pneumatically or mechanically operated. Figure 7 shows that slide plates 43, 44 have been fitted on the side faces of the projections 40, 41, which slide plates slide over one another when conveyor 6 and the clamping element 9 are placed in contact with one another, such that the clamping jaws 10, 11 are pushed towards one another whilst the clamping jaws 7, 8 are pushed apart so that the film 5 is transferred from the conveyor 6 to the clamping element 9.

## Claims

1. Method for applying a protective film (5) to a shaped surface (16, 17, 18) of a vehicle (1), a film sheet (5) being unwound from a stock roll (4) and brought into adhesive contact with the surface of the vehicle, characterised in that:

- the film sheet (5) is brought under tension alongside or above the shaped surface to be covered,
- a hollow mould (13, 14, 15) having the shape of the shaped surface is brought close to the film sheet, which mould is provided with a resilient, porous inner surface (13', 14', 15', 19, 20, 21), as well as with pressure means (22, 23, 24, 25, 26) for applying a vacuum and/or overpressure to the inner surface,
- a vacuum is applied to the inner surface (13', 14', 15', 19, 20, 21) of the mould and the film sheet is drawn into contact with the inner surface of the mould by suction,
- the film sheet is cut through by cutting means (34, 35, 36) around the periphery of the mould, and
- the mould is pushed against the shaped surface so that the film is attached to the shaped surface such that it adheres.

2. Method according to Claim 1, characterised in that after the mould (13, 14, 15) has been pushed against the shaped surface (16, 17, 18) an overpressure is applied to the inner surface (13', 14', 15', 19, 20, 21) by the pressure means (22, 23, 24, 25, 26).

3. Method according to Claim 1 or 2, characterised in that
   a. a free end of the film sheet (5) is clamped in a conveyor (6),
   b. the conveyor (6) is moved to a stationary clamping device (9) located some distance away, so that the film sheet (5) is unwound from the stock roll (4),
   c. the conveyor (6) transfers the free end of the film sheet (5) to the clamping device (9),
   d. the conveyor (6) is returned to the stock roll (4) and once again brought into clamping engagement with the film sheet (5), close to the stock roll (4),
   e. the mould (13, 14, 15) is brought into engagement with the film sheet (5) and the cutting means (34, 35, 36) are activated,

f. the film sheet (5) is cut through across its width at a position between the conveyor (6) and the stock roll (4) and is transferred to a take-up roll (12),

g. the mould (13, 14, 15) is brought into contact with the shaped surface, after which

h. steps a. to g. are repeated.

4. Method according to Claim 3, characterised in that in step f. the clamping device (9) is released and the residual film sheet is wound on the take-up roll (12), the conveyor (6) being brought towards the take-up roll (12) during taking up on the take-up roll (12) and the film sheet (5) remaining under a predetermined tension as a result of the action of a clamping device (27).

5. Method according to Claim 1, 2, 3 or 4, characterised in that the film sheet (5) is provided with an adhesive on one side.

6. Installation for applying a film to a shaped surface (16, 17, 18) of a vehicle (1), comprising at least a mould (13, 14, 15) having essentially the shape of the shaped surface (16, 17, 18), which mould is movable away from and into a position in which it exerts contact pressure and is provided with a resilient porous inner surface (13', 14', 15', 19, 20, 21), as well as pressure means (22, 23, 24, 25, 26) for applying a vacuum to the inner surface, and cutting means (34, 35, 36) for cutting through the film sheet around the periphery of the mould.

7. Installation according to Claim 6, characterised in that the installation is provided with a stock spool (3) to take a film roll (4), tensioning means (6, 9, 27) for stretching between them a film sheet section with a stationary clamping device (9) located some distance away from the stock spool (3) and a conveyor (6) movable to and fro between the stock spool (3) and the clamping device (9).

8. Installation according to Claim 7, characterised in that the clamping device (9) and the conveyor (6) are provided with projections (40, 41) which face one another and which engage in one another when the conveyor (6) is placed in contact with the clamping device (9) in order to transfer the film (5) from the conveyor (6) to the

clamping device (9).

9. Installation according to Claim 7 or 8, characterised in that the clamping device (9) and the conveyor (6) each have two clamping jaws (10, 11; 7, 8) which are movable with respect to one another and which each have a number of projections (40, 41) located some distance away, the projections (40, 41) of the clamping device (9) being located between the projections of the conveyor (6) when the clamping device (9) and the conveyor (6) are positioned next to one another.

10. Installation according to Claim 9, characterised in that the clamping device (9) and the conveyor (6) are provided with opening elements (43, 44) which, when the clamping device (9) and the conveyor (6) are positioned next to one another, engage in one another in such a way that the jaws (7, 8) of the conveyor (6) are opened and the jaws (10, 11) of the clamping device (9) are closed.

11. Installation according to one of Claims 6 to 10, characterised in that the inner surface (13', 14', 15', 19, 20, 21) is made of a porous, resilient plastic or rubber.

12. Installation according to one of Claims 6 to 11, characterised in that a number of differently shaped moulds (13, 14, 15) are rotatably mounted on an arm that is movable out of and into the position in which contact pressure is exerted.

## AMENDED CLAIMS

[received by the International Bureau on 21 March 2000 (21.03.00); original claim 1 amended; new claim 2 added; original claims 2-12 renumbered as claims 3-13; other claims unchanged (3 pages)]

1. Method for applying a protective film (5) to a shaped surface (16, 17, 18) of a vehicle (1), a film sheet (5) being unwound from a stock roll (4) and brought into adhesive contact with the surface of the vehicle, characterised in that:

- the film sheet (5) is supplied under tension,
- a hollow mould (13, 14, 15) having the shape of the shaped surface is brought close to the film sheet, which mould is provided with a resilient, porous inner surface (13', 14', 15', 19, 20, 21), as well as with pressure means (22, 23, 24, 25, 26) for applying a vacuum and/or overpressure to the inner surface,
- a vacuum is applied to the inner surface (13', 14', 15', 19, 20, 21) of the mould and the film sheet is drawn into contact with the inner surface of the mould by suction,
- the film sheet is cut through by cutting means (34, 35, 36) around the periphery of the mould, and
- the mould is pushed against the shaped surface so that the film is attached to the shaped surface such that it adheres.

2. Method according to claim 1, characterised in that first the film sheet (5) is brought alongside or above the shaped surface to be covered, whereafter the hollow mould (13, 14, 15) is brought into contact with the film sheet (5).

3. Method according to Claim 1 or 2, characterised in that after the mould (13, 14, 15) has been pushed against the shaped surface (16, 17, 18) an overpressure is applied to the inner surface (13', 14', 15', 19, 20, 21) by the pressure means (22, 23, 24, 25, 26).

4. Method according to Claim 1, 2 or 3, characterised in that
   a. a free end of the film sheet (5) is clamped in a conveyor (6),
   b. the conveyor (6) is moved to a stationary clamping device (9) located some distance away, so that the film sheet (5) is unwound from the stock roll (4),
   c. the conveyor (6) transfers the free end of the film sheet (5) to the clamping device (9),
   d. the conveyor (6) is returned to the stock roll (4) and once again brought into

clamping engagement with the film sheet (5), close to the stock roll (4),

e. the mould (13, 14, 15) is brought into engagement with the film sheet (5) and the cutting means (34, 35, 36) are activated,

f. the film sheet (5) is cut through across its width at a position between the conveyor (6) and the stock roll (4) and is transferred to a take-up roll (12),

g. the mould (13, 14, 15) is brought into contact with the shaped surface, after which

h. steps a. to g. are repeated.

5. Method according to Claim 4, characterised in that in step f. the clamping device (9) is released and the residual film sheet is wound on the take-up roll (12), the conveyor (6) being brought towards the take-up roll (12) during taking up on the take-up roll (12) and the film sheet (5) remaining under a predetermined tension as a result of the action of a clamping device (27).

6. Method according to any of the preceding claims, characterised in that the film sheet (5) is provided with an adhesive on one side.

7. Installation for applying a film to a shaped surface (16, 17, 18) of a vehicle (1), comprising at least a mould (13, 14, 15) having essentially the shape of the shaped surface (16, 17, 18), which mould is movable away from and into a position in which it exerts contact pressure and is provided with a resilient porous inner surface (13', 14', 15', 19, 20, 21), as well as pressure means (22, 23, 24, 25, 26) for applying a vacuum to the inner surface, and cutting means (34, 35, 36) for cutting through the film sheet around the periphery of the mould.

8. Installation according to Claim 7, characterised in that the installation is provided with a stock spool (3) to take a film roll (4), tensioning means (6, 9, 27) for stretching between them a film sheet section with a stationary clamping device (9) located some distance away from the stock spool (3) and a conveyor (6) movable to and fro between the stock spool (3) and the clamping device (9).

9. Installation according to Claim 8, characterised in that the clamping device (9) and

the conveyor (6) are provided with projections (40, 41) which face one another and which engage in one another when the conveyor (6) is placed in contact with the clamping device (9) in order to transfer the film (5) from the conveyor (6) to the clamping device (9).

10. Installation according to Claim 8 or 9, characterised in that the clamping device (9) and the conveyor (6) each have two clamping jaws (10, 11; 7, 8) which are movable with respect to one another and which each have a number of projections (40, 41) located some distance away, the projections (40, 41) of the clamping device (9) being located between the projections of the conveyor (6) when the clamping device (9) and the conveyor (6) are positioned next to one another.

11. Installation according to Claim 10, characterised in that the clamping device (9) and the conveyor (6) are provided with opening elements (43, 44) which, when the clamping device (9) and the conveyor (6) are positioned next to one another, engage in one another in such a way that the jaws (7, 8) of the conveyor (6) are opened and the jaws (10, 11) of the clamping device (9) are closed.

12. Installation according to one of Claims 7 to 11, characterised in that the inner surface (13', 14', 15', 19, 20, 21) is made of a porous, resilient plastic or rubber.

13. Installation according to one of Claims 7 to 12, characterised in that a number of differently shaped moulds (13, 14, 15) are rotatably mounted on an arm that is movable out of and into the position in which contact pressure is exerted.

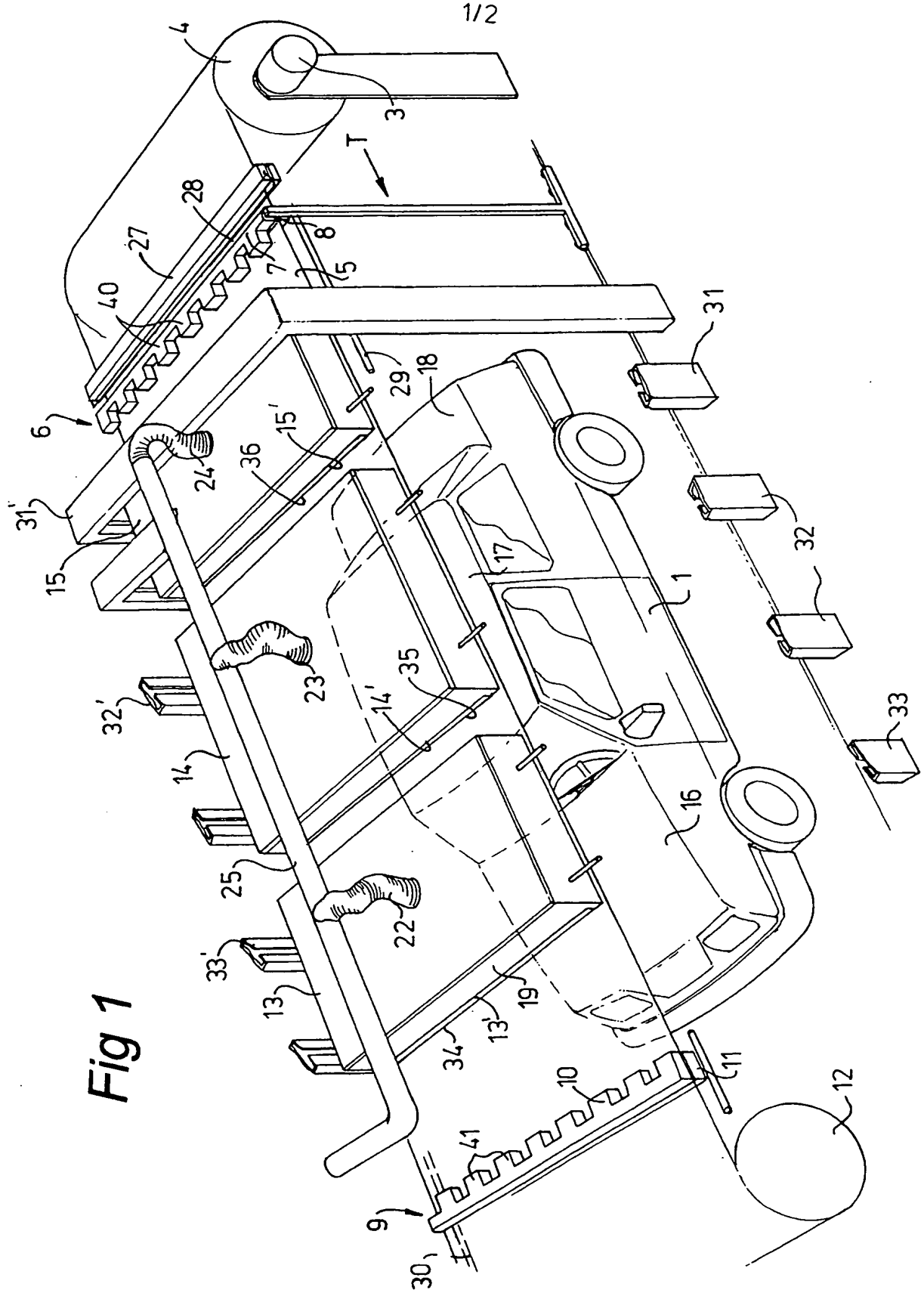
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Fig 1

Fig 2

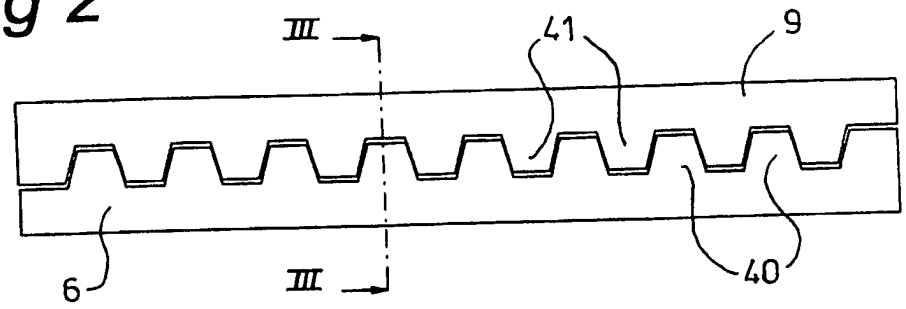



Fig 3

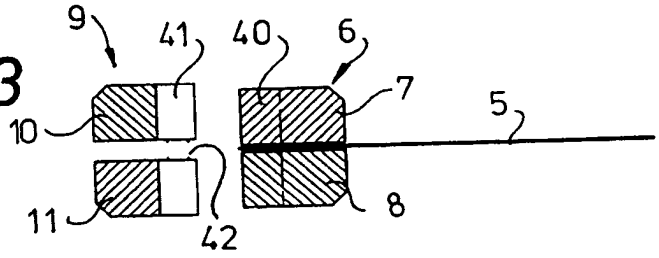



Fig 4

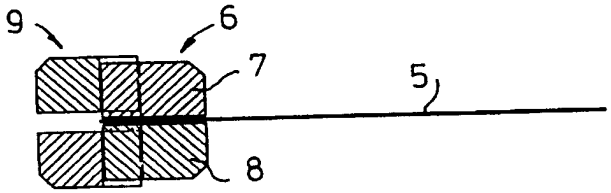



Fig 5

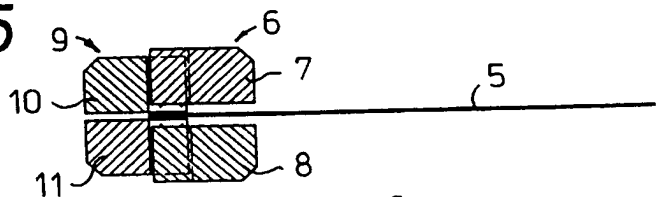



Fig 6

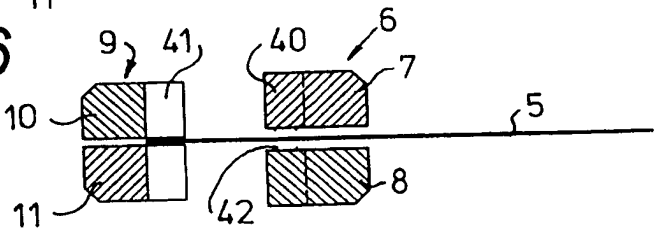
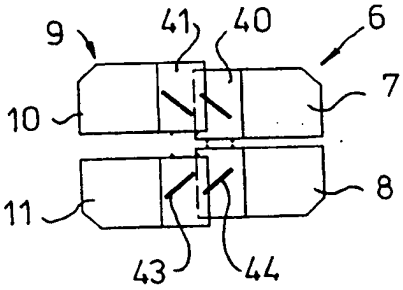



Fig 7



# INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/NL 99/00635

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B29C63/02 B65B41/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B29C B29D B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 13 January 2000 | 21/01/2000 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Lanaspeze, J |

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Inter nal Application No
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